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# Grand Push Auto: A Car Based Exertion Game

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**Abstract**

Grand Push Auto is an exertion game in which players aim to push a full sized car to ever increasing speeds. The re-appropriation of a car as essentially a large weight allows us to create a highly portable and distributable exertion game in which the main game element has a weight of over 1000 kilograms.

In this paper we discuss initial experiences with GPA, and present 3 questions for ongoing study which have been identified from our early testing:

How might we appropriate existing objects in exertion game design, and does appropriation change how we think about these objects in different contexts, for example environmental awareness?

How does this relate to more traditional sled based weight training?

How can we create exertion games that allow truly brutal levels of force?

**Author Keywords**

Car; game; exertion; exertion game;

**ACM Classification Keywords**

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous;

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## Introduction

Car games have been a staple of gaming not only since the earliest days of arcades [14] and home consoles [1], but even in pre-digital board games [7]. Such games primarily celebrate one aspect of the car, the possibilities it gives for speed and driving excitingly fast. In our game, Grand Push Auto (GPA), we instead highlight the fact that a car is a very heavy lump of metal and other materials. For maximum realism, players must push a full sized, real car. The car engine is disabled at all times, as in GPA, the player is the engine whose target performance is controlled by the game. A minimum of two participants are required at any time, a driver and at least one player.



**Figure 1.** Driver and player in GPA

## The Game Hardware

The car in GPA is a normal unmodified car in neutral gear. For safety reasons (active brake lights and unlocked steering), on-board electricity is turned 'on' without the ignition being started. A qualified driver is in control at all times to ensure the car is moved safely, to put on brakes when players are resting, and release them when players push. Any number of players push the car from behind. Car speakers out of an open window present instructions and music to players from a windscreen mounted Android smartphone, which acts as a game controller by implementing game logic, and is also the interface to players and driver. The phone is mounted so it can be seen both by the driver in the car, and also by players through the rear window.

## Gameplay

Once players are ready, the driver touches the screen to start GPA. All other interaction with the game is via the audio channel and movement of the car. After a voice counts down, a target speed is shown. The players' challenge is to accelerate the car to this speed. GPA tracks speed and plays motivational music until it detects the speed is reached. Then GPA allows players to rest, signaling this with a soundtrack change to chill-out music. The driver beeps the horn as warning<sup>1</sup> and brakes the car. After twenty seconds pause, the next level begins and GPA sets a slightly higher target speed. The game is over whenever the players can no longer keep pushing or can't reach the speed and decide to stop. Players are scored based on how many levels they can complete.

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<sup>1</sup> The horn beep was added in early testing, where players got carried away, and didn't notice the music change. Braking the vehicle whilst they continued to run and push caused sudden uncomfortable interruptions to game flow and immersion.

### **Research Directions for Grand Push Auto**

In the following sections, we describe 3 key questions which are driving our further research interest in GPA and related games, with brief summaries of related research and our potential research directions.

### **Appropriation of Existing Objects for Games**

*How might we appropriate existing objects in exertion game design, and does appropriation change how we think about these objects (and does this for example relate to raised environmental awareness)?*

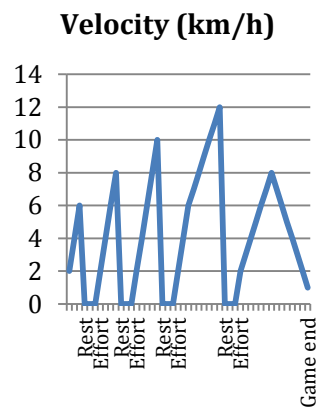
Street sports such as skateboarding have for a long time appropriated elements of the street scenery and items in the environment to do tricks on [2]. Lessel et al.'s Omnisports [8] brings a similar approach to fitness training exertion games, allowing people to create 'digital fitness trails' based on doing exercises on elements of the environment such as benches and trees. Appropriating objects for weight training is also quite common, with everything from bottles of salad dressing [11] to young babies [5] being recommended as training weights for those who lack access to weights (or have no baby free time).

In these sports and exercises, the objects being used are mostly used for their physical characteristics, standing in for commercially bought or crafted weights and obstacles. With the framing of the game around the car, and the name GPA being a homage to the Grand Theft Auto [12] series of games, we make it clear that the intention is not just to use a car as a weight training sled (see below), the fact that it is a motorized vehicle is meaningful in itself.

GPA differentiates itself from typical car-based action or racing games through encouraging people to think differently about the car as an object. In this way GPA, can be seen as a kind of critical play [6]

Specifically, GPA exposes the weight of the car to players, and turns a normally effortless task of moving a car a few hundred metres into a serious physical endeavor. This unique experience exceeds the purely mindful understanding of these facts and can be seen as embodied learning [4]. Therefore we believe instead that this game may cause motorists to consider how much energy is contained in the petrol they burn in their engine for similar tasks. Ultimately this may lead to reconsidering their wider car use behaviour, with the potential for large health, environmental, and social benefits.

Beside these theories, there are other topics to consider with relation to further study of GPA. One is more generally how one might appropriate other common objects as game elements in a way which meaningfully relates to the wider social construction of the object in addition to using the unique physical characteristics of the chosen item. For example, one might consider a game that makes use of household storage furniture as a game interface, and creates a game which relates to the things that people store within their chests and cupboards, or even considering building games using found objects such as trash collected in public parks.



**Figure 2** Velocity Profile of a typical game of GPA



**Figure 3** Multi Player GPA

### Grand Push Auto and Sports Training

*How can games like GPA relate to more traditional weight pushing sports training?*

When we built GPA, none of us had any experience pushing cars for any distance. One thing that was quite surprising to us and to pilot test players, is the level of exertion required to push a car, and the whole body nature of that exertion. Rather than be upper body focused as we'd expected, even short periods of play left legs, back, core and arms aching, it was not possible to push cars for more than 2-3 minutes per session. Because of this, we implemented an interval based play scheme, in which players try to achieve a target speed and then may rest for 20 seconds (see Figure 2 for an example of a typical velocity profile for GPA).

From a sports training point of view, this is classic interval training; with the car providing a large resistance for the active section of the interval, and moments of relaxation cued by the audio signals in the game. The car is similar to a weight training "proowler" sled, a large carrier for gym weights that is designed to be pushed along the floor as a form of exercise. In addition, the design of GPA, containing successively more difficult levels, directly implements the "training to failure" model that is currently so popular in strength training [13].

As a form of physical workout, GPA has several advantages and disadvantages compared to traditional weight pushing training. Unlike weight training equipment, GPA provides its own organization to the activity, reducing the need for external coaching or routines that is typical in weight sled training. It also

uses commodity equipment which many people already have access to. It is also simple to play with multiple cooperating players (**Figure 3**). During the testing sessions bystanding team members were motivated to join in during highly demanding game rounds. This social aspect of group building is advantageous for team weight training exercises and especially useful for team sports such as rugby. Clearly there are some constraints to the use of GPA however. The most obvious constraint is the requirement of a safe, empty stretch of road such as an empty car park, private drive or flat field. This obviously limits its applicability. It also has no way to control for the exact quantity of weight, useful especially for the social media aspect of comparing results. Nevertheless changing the car or adding and removing passengers allows simple manipulations at a single localized game event.

The use of a combination of commodity equipment in GPA poses some interesting research questions from a sports training viewpoint. In particular, we intend to consider how such ad-hoc, game based exercise could be integrated into a structured training plan as used in more traditional athletic training. In an era when expensive gym subscriptions, training equipment, sports science, personal trainers and dietary supplements are increasingly necessary for participation in exercise and strength training, we believe there is great value in exploring a more accessible approach based on the appropriation of everyday objects, and inspired by DIY maker culture [3].



**Figure 4** A player falls to the floor with exhaustion.

### GPA as a Brute Force Interaction

*How can we create truly brutal exertion games, in which the player both gives out and receives intense amounts of force?*

Watching players in GPA, and listening to them grunting as they push, GPA is clearly what Mueller et al. [10] describe as a brute force exertion game, a game in which the players use powerful and brutal movements to interact with the game. Interestingly one of the challenges of creating such games is the creation of suitably robust interfaces; GPA side-steps this by using a car, an object which is already designed to undergo significantly more force than a person can put into it. Using large and difficult to move objects like cars offers a promising way of creating brute force interactions, by creating systems which can take essentially as much force as the player is able to put in.

Mueller et al. [10] discuss how they designed their system so that players can apply large amounts of force to the game screen, which is a padded mattress. However that mattress limits how much feedback the player receives for safety reasons. GPA takes a different approach - rather than 'safe' levels of feedback described in [10], GPA feeds back a large proportion of the force directly to the player as resistance to moving. This makes for a different character of experience, as both the input and the physical feedback are brutal for the player. We call this '*two way brutality*', to distinguish from the input only brutality of Mueller et al. [10]. **Figure 4** shows the effect of such brutal efforts, where one player was pushing so hard that by the time the game allowed them a rest, he fell to the floor with exhaustion.

The brute physical force required to play GPA also creates an interesting opportunity for players to engage in a sort of phenomenological reflection on their own physicality. One of the most popular themes through the history of games research has been the potential of games to provoke feelings of immersion or presence in a virtual world. A feeling of immersion in a virtual world necessarily requires a loss of presence in the physical world – players forget they are sitting on a couch in a sitting room, breathing, expending energy as time is passing. In contrast, GPA specifically acts as a stimulus that directs players' attention to the physical nature of their bodies. They become intimately aware of the car's weight, the slippery surface of the bodywork, the gravel of the road, strain on legs and back, blood pumping through their arteries and breath in their lungs. We are excited by the potential of brute force games to provoke in players this feeling of presence in their own skin, and to recognize that as an enjoyable experience.

We are currently carrying out further research on ways of creating games which involve two way brutality; so far, we have identified three key ways of doing this:

- 1) Using immobile or hard to move objects, so that the frictional forces or gravity create player feedback whenever the objects are moved.
- 2) Using large actuators for player feedback (e.g. [9]), although as discussed in [10] creating actuators that are able to apply large forces to the body has inevitable safety concerns.
- 3) Directly pitting players against each other, as in traditional contact sports, although this has potential limitations if player strengths are unbalanced, and requires multiple players.



**Figure 5** Pushing through the pain

### Safety and Legality of GPA

Grand Push Auto uses a real car as an interface, which creates certain safety and legal considerations. When the engine is off, braking and steering assistance is significantly reduced – whilst it is not hard to brake at the slow speeds the car is being pushed at, it is very important to play on relatively level ground. We also identified two main safety risks – firstly the car colliding with a person or running over the player; secondly collision with other vehicles or the surroundings. In pilot testing, we minimized these risks by using an empty car park, an experienced driver and spotters to check for incoming cars.

Using such a highly regulated object as our game controller also poses questions as to how legally practical such a game is. It is almost certain that no one could ever commercially release GPA. In the UK, we believe playing GPA on non-public land is legal, as long as a driver is in control of the car at all times. On public roads, the legality of pushing a car for anything other than making it safe after a breakdown is open to question, particularly given that the braking and steering systems are less effective with the engine off.

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